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Impact of chemical potential on the reflectance of graphene in the infrared and microwave domains

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Abstract

© 2018 American Physical Society. The reflectance of graphene is investigated in the framework of the Dirac model with account of its realistic properties, such as nonzero chemical potential and band gap, at any temperature. For this purpose, the exact reflection coefficients of the electromagnetic waves on a graphene sheet expressed via the polarization tensor and ultimately via the electrical conductivity of graphene have been used. The reflectance of graphene is computed as a function of frequency and chemical potential at different temperatures and values of the band-gap parameter. The minimum values of the reflectance are found which are reached in the infrared domain at the points of vanishing imaginary part of the conductivity of graphene. For a gapped graphene, the maximum reflectance equal to unity is reached at the points where the imaginary part of conductivity diverges. The computational results demonstrate an interesting interplay between the band gap and chemical potential in their combined effect on the reflectance. Specifically, there are wide frequency intervals where the reflectance of graphene increases with increasing chemical potential and decreasing band gap. The numerical computations are found to be in good agreement with the analytic asymptotic expressions in the regions of their applicability. Several technological areas, where the obtained results could be used, are listed.

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